CLAIMS

1 A *p-n* junction electroluminescent (EL) device, comprising multiple layers of:

a semiconductor-on-insulator substrate;

a first *p*-doped Si layer grown on the said substrate,

part of the layer being oxidized to isolate bottom electrodes of said device;

a thin-layer of Si which allows further epitaxial growth;

a *p*-doped wide energy gap semiconductor layer grown epitaxially;

a layer comprising pseudomorphic cladded quantum dots nanocrystals (CNCs) deposited on the said wide energy gap layer;

a thin wide energy gap semiconductor layer having n-type conductivity, grown on the CNC layer; and

a metal layer forming a plurality of top contact electrodes deposited on the wide energy gap semiconductor layer having appropriate patterned regions to confine current conduction in desired pixels of said EL device.

2. A Schottky barrier electroluminescent device, comprising multiple layers on a semiconductor on insulator substrate having:

a first *n*-doped Si layer grown on the said substrate, having a plurality of rows of oxide isolation separating bottom electrodes of said EL device;

a thin-layer of Si which allows further epitaxial growth;

a *n*-doped wide energy gap semiconductor layer grown epitaxially;

a CNC layer of pseudomorphic cladded quantum dots nanocrystals (CNCs) deposited on said wide energy gap layer;

a thin wide energy gap semiconductor layer grown on the CNC layer; and

a metal layer deposited selectively on the wide energy gap semiconductor layer to form a top Schottky contact electrodes.

3. An EL device of claim 1, wherein said CNC layer are selected from the group of semiconductor materials consisting of $Zn_xCd_{1-x}Se$ (core) - $Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - $Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - ZnMgSSe (cladding),

$In_xGa_{1-x}N$ (core) - GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)-ZnMgS (cladding).

4. An EL device of claim 2, wherein said CNC layer are selected from the group of semiconductor materials consisting of $Zn_xCd_{1-x}Se$ (core) - $Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - $Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - ZnMgSSe (cladding), $In_xGa_{1-x}N$ (core) - GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)-ZnMgS (cladding).

5. An EL device of claim 3, wherein said CNC layer is sandwiched between compatible wide energy gap semiconductor layers selected from the group of semiconductors consisting of $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bSe_{1-b}$, $Zn_aBe_{1-a}S_bSe_{1-b}$, $Al_cGa_{1-c}N$, and AlInN.

6. An EL device of claim 1, wherein said *p-n* junction is reverse-biased to operate said device in the avalanche mode.

7. An EL device of claim 1, wherein said *p-n* junction is forward-biased to operate in injection mode.

8. An EL device of claim 1, wherein the CNC layer comprises multiple layers of CNCs sandwiched between epitaxially grown thin film layers of wide energy gap semiconductors.

9. An EL device of claim 2, wherein the CNC layer comprises multiple layers of CNCs sandwiched between epitaxially grown thin film layers of wide energy gap semiconductors.

10. An EL device as described in claim 1, wherein said CNC layer has more than one sublayers stacked to emit different colors and white-light

11. An EL device as described in claim 2, wherein said CNC layer has more than one sublayers stacked to emit different colors and white light

12. An EL device as described in claim 1, wherein ~~more than~~ one said CNC layer are deposited to produce ~~red, green~~ and blue pixel elements for a display panel.

13. An EL device as described in claim 2, wherein more than one said CNC layer are deposited to produce ~~red, green~~ and blue pixel elements for a display panel.

14. An electroluminescent (EL)device, comprising multiple layers of:

a plurality of transparent electrodes on an insulator substrate;

a first dielectric layer deposited on said set of transparent electrodes;

a CNC layer comprising pseudomorphic cladded quantum dots nanocrystals (CNCs) deposited on said dielectric layer;

a second dielectric layer deposited on said CNC layer; and

a metal layer forming top contact electrode is deposited on the second dielectric layer.

15. An electroluminescent device of claim 14, wherein the CNC layer is selected from the group of said CNC consisting of: $Zn_xCd_{1-x}Se$ (core)-$Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core)-$Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core)-ZnMgSSe (cladding), $In_xGa_{1-x}N$ (core)- GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)-ZnMgS (cladding).

16. An electroluminescent device of claim 14, wherein the first dielectric layer and the second dielectric layer are selected from the group consisting of SiON, Ta_2O_5, $Ba_xSr_{1-x}TiO_3$, PLZT, $Zn_xMg_{1-x}S$, $Zn_xBe_{1-x}S$, etc., and their combination.

17. An EL device of claim 14 wherein said EL device is operating in the avalanche mode using an AC bias.

18. An electroluminescent (EL) device, comprising multiple layers of:

a *p*-doped silicon-on-insulator (SOI) substrate;

a *p*-doped wider energy gap semiconductor layer grown epitaxially on said *p*-doped SOI substrate;

a CNC layer of pseudomorphic cladded quantum dots nanocrystals (CNCs) deposited on the insulator of said SOI substrate;

a hole-blocking layer deposited on said CNC layer; and

a metal layer forming top contact electrodes deposited on the hole-blocking layer.

19. An electroluminescent device of claim 18, wherein the CNC layers comprise of $Zn_xCd_{1-x}Se$ (core)-$Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core)-$Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$(core)-ZnMgSSe (cladding), $In_xGa_{1-x}N$ (core)-GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)- ZnMgS (cladding).

20. An electroluminescent device of claim 18, wherein the hole-blocking layer is selected from the group consisting of Ta_2O_5, $Zn_xMg_{1-x}S$, $Zn_xBe_{1-x}S$, and ZnMgBeSe.

21. An EL device of claim 18, wherein said EL device operates in an injection mode using a forward bias across said device.

22. An electroluminescent (EL) device, comprising multiple layers of:

an *n*-doped silicon layer on insulator substrate with contact electrodes;

a *n*-doped wider energy gap semiconductor layer grown epitaxially on said Si layer;

a CNC layer of pseudomorphic cladded quantum dots nanocrystals (CNCs) deposited on said wider energy gap semiconductor layer;

a hole-transporting layer of wide-energy gap organic semiconductor on said CNC layer;

an organic conductive layer deposited on said hole-transporting layer; and

a metal layer forming top contact electrodes deposited on the said organic conductive layer.

23. An electroluminescent device of claim 22, wherein more than one said CNC layer are selected from the group consisting of: $Zn_xCd_{1-x}Se$ (core)-$Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core)-$Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core)-ZnMgSSe (cladding), $In_xGa_{1-x}N$ (core)-GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)- ZnMgS (cladding).

24. An electroluminescent device of claim 22, wherein the *n*-type wide-energy gap inorganic semiconductor layer is selected from the group consisting of semiconductors $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bS_{1-b}$, $Zn_aBe_{1-a}S_bS_{1-b}$, $Al_cGa_{1-c}N$, ZnMgBeSe, and AlInN.

25. An electroluminescent device of claim 22, wherein the hole-transporting layer is selected from the group consisting of PVK and CBP.

26. An electroluminescent device of claim 22, wherein the hole-transporting layer is doped with an oxidative agent selected from the group of compounds such as Fe^{III}citrate and Fe^{III}oxalate.

27. An EL device as described in claim 26, wherein the oxidative agent is constructed with a thin shield around the oxidizing agent utilizing appropriate counter ions, chelating agents, surfactants and dentrimers.

28. An EL device as described in claim 23, wherein the CNC nanocrystals are constructed with a thin shield around the outer core utilizing appropriate counter ions, chelating agents, surfactants and dentrimers.

29. An electroluminescent device of claim 22, wherein the CNC layer is merged with the hole-transporting layer.

30. An electroluminescent device of claim 29, wherein the composite of CNC nanocrystals and hole-transporting layer is doped with oxidative agent, selected from a

group of compounds such as Fe^{III}citrate and Fe^{III}oxalate; the said oxidative agents are constructed with a thin shield around them utilizing appropriate counter ions, chelating agent, surfactants and dentrimers.

31. An electroluminescent device of claim 29, wherein the composite of CNC nanocrystals and hole-transporting layer is doped with oxidative agent selected from the group of compounds consisting of Fe^{III}citrate or Fe^{III}oxalate; the said CNCs are constructed with a thin shield around them utilizing appropriate counter ions, chelating agent, surfactants and dentrimers.

32. An EL device as described in claim 1 wherein said CNC layer is coated with an environmental passivation layer selected from the list of compounds consisting of ZnO, SiO_x, SiON, and Ta_2O_5.

33. An electroluminescent (EL) device, comprising multiple layers on an insulator substrate of:

a transparent electrode;;

an organic conductive layer deposited on said transparent electrode;

a composite layer, comprising CNC nanocrystals and an organic hole-transporting agent on said organic conductive layer;

an electron transporting organic layer on said composite layer;

a thin (8-20 Å) tunneling layer deposited on electron transporting layer; and

a metal layer forming top contact electrode deposited on the said tunneling layer.

34. An electroluminescent device of claim 33 wherein the composite layer and hole-transporting layer is doped with oxidizing agent selected from the group of compounds consisting of Fe^{III}citrate and Fe^{III}oxalate; and

said oxidative agents is constructed with a thin shield around said CNC nanocrystals utilizing appropriate counter ions, chelating agent, surfactants and dentrimers.

35. An electroluminescent device of claim 33 wherein the composite of CNC nanocrystals and hole-transporting layer is doped with oxidative agent selected from the group of compounds consisting of Fe^{III}citrate and Fe^{III}oxalate; and

the said CNC nanocrystals are constructed with a thin shield around them utilizing appropriate counter ions, chelating agent, surfactants and dentrimers.

36. An EL device of claim 33, wherein the composite of CNCs and hole-transporting layer are separated in individual layers.

37. An electroluminescent device of claim 36, wherein the hole transporting layer is doped with an oxidative agent selected from the group of compounds consisting of Fe^{III}citrate and Fe^{III}oxalate; and

the said oxidative agents are constructed with a thin shield around them utilizing appropriate counter ions, chelating agent, surfactants and dentrimers.

38. An electroluminescent device, comprising multiple layers on an insulator substrate of:

a transparent electrode;

a viscous composite, comprising CNCs, hole-transporting organic semiconductors, oxidative agents, soluble salts and low vapor pressure viscosity-modifying agents;

wherein said viscous composite is sandwiched between the said transparent electrode and

a second electrode, which is separated by uniform spacers.

39. An electroluminescent device of claim 38, wherein said spacers are made of elastomers containing appropriate holes for containing said viscous composite.

40. An electroluminescent device of claim 39, wherein the holes in the said elastomeric spacers are filled with said viscous composites with distinct light emission characteristics.

41. An EL device as described in claim 40, wherein the viscous composite is introduced by a method selected from the group consisting of screen-printing and ink-jet printing.

42. An electroluminescent (EL) device, comprising multiple layers, on an insulator substrate, of:

a n-doped silicon layer, comprising thin doped Si $n/n+$ regions separated by insulating regions, such as SiO_2, and contacted to form bottom electrodes;

a thin-layer of Si which allows further epitaxial growth;

a p-type Si layer, having addressing contact electrodes;

a thin (about 10 nm) SiO_2 layer deposited and patterned with a pitch of about 0.1 microns;

a p-Si layer forming nanotips;

an n-type wide energy gap layer selected from the group of semiconductors consisting of $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bS_{1-b}$, $Zn_aBe_{1-a}S_bS_{1-b}$, $Al_cGa_{1-c}N$, ZnMgBeSe, and AlInN stacked on the p-Si layer layer with nanotips;

a layer comprising cladded quantum dots;

a wide gap semiconductors layer selected from the group of semiconductors consisting of: $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bS_{1-b}$, $Zn_aBe_{1-a}S_bS_{1-b}$, $Al_cGa_{1-c}N$, ZnMgBeSe, and AlInN;

a layer forming contact electrodes;

said set of electrodes being appropriately biased and addressed to create a two-dimensional display.

43. An EL device as described in claim 42 wherein the layers starting from the substrate are of p-n-p configuration; said bottom electrodes are $p/p+$ type, the middle layer having nanotips is n-type, and the wide energy gap layers sandwiching the nanoparticles are p-type semiconductors.

43 44. An EL device as described in claim 1 where the bottom electrodes are separated by technique other than oxidation such as reverse biased junctions.